APPENDIX H

COMMUNICATIONS

Introduction

This appendix is intended for users, supervisors, and planners. It provides basic guidance on planning and employing communications assets. The development of operating procedures and doctrinal changes is an evolutionary process. The information in this appendix is modeled on an objective light infantry division (LID) (L-series) TOE. Users operating under modification TOEs (MTOEs) must understand that procedures and methods outlined herein are a **recommended** solution and may be tailored to meet specific requirements.

Communications Systems

Radio is the primary means of voice and digital communications with the field artillery. Separate radio nets are established for command and control, fire direction, fire support coordination, and administration and logistics. The execution of AirLand Battle doctrine requires the skillful use of all communications resources. Thus, close coordination and a clear understanding of radio net structure are necessary.

With restrictions on light division personnel and on weight and size of equipment, FA units must have reliable and efficient communications systems with fewer assets. The growth and development of requirements for fire support, fire direction, administration and logistics, and command and control communications over long distances have placed even more responsibilities on the commander.

A communications system is the result of a plan designed to fulfill the requirements of a light infantry division mission. As a result of net standardization, units can quickly and accurately communicate in combat. Command discipline must be established so that standard net structures and purposes are not arbitrarily changed except to tailor for a specific modified mission. This tailoring is based on the factors of METT-T. Standard net structures (net title, purpose, users, and equipment) should be defined in unit SOP and should be kept current as changes in procedures and/or systems occur.

Communications system planning must include advance coordination for SOI and COMSEC materials for secure operations. Consider the fire support scheme of maneuver for planned, on-order, and anticipated missions.

Radio Net Structures

Voice Communications

Company-Level Fire Support. In units not equipped with digital devices, company fire support personnel should operate in the following nets:

- Maneuver battalion mortar fire direction net FM (voice). This net is used for battalion mortar fire direction and voice coordination between fire support entities within the maneuver battalion. The battalion FSE is the net control station.
- Direct support battalion fire direction net 1, 2, or 3 FM (voice). This net is used for FA fire direction. There are three FA fire direction nets at DS battalion level. Normally, they are assigned on the basis of one per maneuver battalion. The FIST headquarters may control calls for fire from its observers on this net. The DS battalion FDC is the NCS.
- Maneuver battalion fire support net FM (voice). This net is used for fire support coordination between maneuver and fire support elements. The battalion FSE is the NCS.

- Maneuver company command/operations net FM (voice). This net is used for command and control by maneuver elements and as an alternate fire support coordination net for non-field-artillery observers (such as scouts). The NCS is the company CP. The company FSO is in this net when he is not physically located with the maneuver commander.

Battalion-Level Fire Support. The battalion fire support personnel operate in the following nets:

- Maneuver battalion fire support net FM (voice) (NCS).
- Maneuver battalion mortar fire direction net FM (voice).
- Direct support battalion fire direction net 1, 2, or 3 FM (voice).
- Maneuver brigade fire support net FM (voice). This is a secure net linking the battalion FSO and FSE to the brigade FSO and FSE and the FA battalion CP. It is used for planning and coordinating fire support within the brigade. The brigade FSE is the NCS.
- Direct support battalion operations/fire net FM (voice). This net is used within the field artillery for fire support planning and coordination. Reinforcing units should use this net. The NCS is the DS battalion operations section.
- Maneuver battalion command/operations net FM (voice) (as required).

Brigade-Level Fire Support. The brigade fire support personnel operate in the following nets:

- Maneuver brigade fire support net FM (voice).
- Div arty command net FM (voice). This secure net links the brigade FSEs with the division FSE and the div arty CP. It is used for command and control. The div arty CP is the NCS.
- Direct support battalion operations/fire net FM (voice).
- Maneuver brigade command/operations net FM (voice). This net is used for dismounted FSO operations.
- Div arty operations/fire direction net 1, 2, or 3 FM (voice) (as required).
- Div arty fire support net amplitude modulated/single sideband (AM/SSB) (voice). This net accomplishes long-distance fire support with elements throughout the division (including separate, air assault, and aviation elements) and brigade FSEs. It is used to plan nuclear and/or chemical fires and to coordinate the delivery of CAS or naval gunfire. The FSE at the division main TOC is the NCS.

Digital Communications

Company-Level Fire Support. In units equipped with forward entry devices (FEDs), the following nets should be used:

- Maneuver battalion mortar fire direction net FM (digital).
- Maneuver company command/operations net FM (voice).
- Direct support battalion fire direction net 1, 2, or 3 FM (digital).
- Maneuver battalion fire support net FM (voice).

Battalion-Level Fire Support. The battalion fire support personnel operate in the following nets:

- Maneuver brigade fire support net FM (voice).
- Direct support battalion operations/fire net FM (digital).
- Maneuver battalion- fire support net FM (voice).
- Direct support battalion fire direction net 1, 2, or 3 FM (digital).

- Maneuver battalion mortar fire direction net FM (digital).
- Maneuver battalion command/operations net FM (voice) (as required).

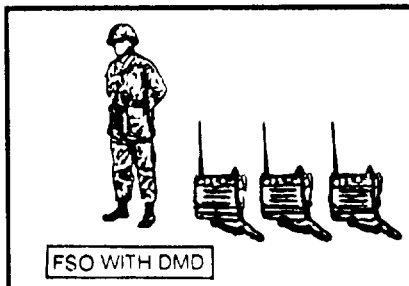
Brigade-Level Fire Support. The brigade fire support personnel operate in the following nets:

- Div arty operations/fire direction net 1, 2, or 3 FM (digital).
- Direct support battalion operations/fire direction net FM (digital).
- Maneuver brigade fire support net FM (voice).
- Div arty command net FM (voice).
- Maneuver brigade command/operations net FM (voice) (as required).
- Div arty fire support net AM/SSB (voice).

Far-Term Communications

Radio net structures will not change appreciably with the advent of the single-channel ground-airborne radio system (SINCGARS).

FIRE SUPPORT TEAM COMMUNICATIONS



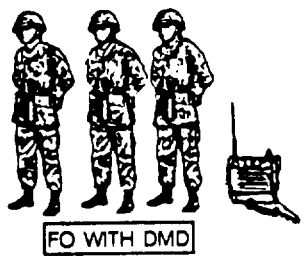
RADIO NETS

DS BN FD 1, 2, OR 3 FM (D)

MVR BN FS FM (V)

MVR BN MORT FD FM (D)

MVR CO CMD/OPS FM (V)



RADIO NETS

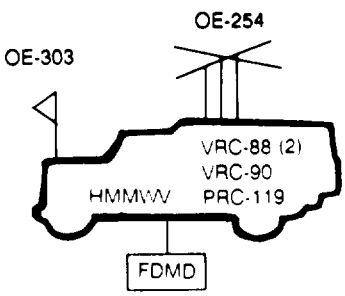
DS BN FD 1, 2, OR 3 FM (D)

MVR BN MORT FD FM (D)

LEGEND:

CMD/OPS	= command/operations	(V)	= voice
DMD	= digital message device	———	= primary net
(D)	= digital	·····	= as needed

BATTALION FIRE SUPPORT ELEMENT COMMUNICATIONS



RADIO NETS

MVR BDE FS FM (V)

MVR BN FS FM (V)

DS BN FD 1, 2, OR 3 FM (D)

MVR BN MORT FD FM (D)

DS BN OPS/F FM (D)

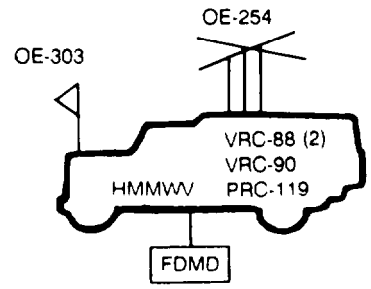
MVR BN CMD/OPS FM (V)

DIV ARTY FS AM/SSB (V)

LEGEND:

FDMD	= FIST digital message device	·····	= as needed
OPS/F	= operations/fire	•••••••	= for air assault raid or interdiction operations
———	= primary net		

BRIGADE FIRE SUPPORT ELEMENT COMMUNICATIONS



RADIO NETS

DIV ARTY CMD FM (V)

MVR BDE FS FM (V)

DS BN OPS/F FM (D)

DIV ARTY OPS/F 1, 2, OR 3 FM (D)

MVR BDE CMD/OPS FM (V)

DIV ARTY FS AM/SSB (V)

LEGEND:

———— = primary net

- - - - - - - - - - = as needed

• • • • • • • • = for air assault raid or interdiction operations

FIRE SUPPORT NET USAGE

NET	FO	FIST	CO FSO	BN FSE	BN FSO	COLT	BDE FSE	BDE FSO	FA BTRY FDC	FA BN FDC	BN MORTARS	DIV FSE (TAC)	DIV FSE (MAIN)	DIV ARTY TOC
Maneuver co cmd/ops net FM (V)		X[1]												
Maneuver bn cmd/ops net FM (V)				X[1]										
Maneuver bde cmd/ops net FM (V)							X[1]							
Maneuver bn FS net FM (V)	X[2]	X	X[3]	X	X[3]	X					X			
Maneuver bde FS net FM (V)				X	X		X	X						
Maneuver bn mortar FD net FM (D)[4]	X[1]	X	X[1]	X		X[5]					X			
DS bn FD net 1, 2, or 3 FM (D)[4]	X[6]	X		X		X[5]			X	X				
DS bn ops/F net FM (D)[4]				X			X			X				
Div arty ops/F net 1, 2, or 3 FM (D)							X			X		X	X	X
Div arty FS net AM/SSB (V)[4]				X[7]			X[7]					X[7]	X[7]	X[7]
Div arty cmd net FM (V)							X			X		X	X	X

[1]As needed.
[2]May enter for voice coordination.
[3]Net used by FSO when separate from the FSE.
[4]When there is no digital capability, this is a voice net.
[5]COLTs will operate in the net directed by brigade FSO.
[6]As directed.
[7]For assault raid or interdiction operations.

Single-Channel Ground-Airborne Radio System

SINCGARS is the new generation combat net radio designed to provide the primary means of command and control. Its main features are its resistance to jamming through frequency hopping and its increased capacity of 2,320 channels. The basic radio is designed on a modular basis to achieve commonality among various system configurations. It can be used in the manpack or vehicular package. It is interoperable with AN/VRC- 12-series radios. The present radio net structures will not change in terms of mission capability, net size, assignment of net stations, or distance covered. Planning considerations, however, require frequency management on a decentralized basis. This means frequency management will be done at battalion level and intensive management by staff and supervisors at all levels of command will be necessary.

Battlefield Electronic CEOI System

The battlefield electronic communications-electronics operation instruction (CEOI) system (BECS) is a decentralized system for frequency management and the publication of unit CEOIs (now called signal operation instructions). The BECS has been designed to provide more responsiveness to rapidly changing and highly mobile battlefield conditions. The system consists of a basic generation unit (BGU) and an electronic notebook (EN). Distribution channels are the same as presently used for the paper SOI.

Loss of Communication

Communication is essential for fire support. If communication with a station is lost, everything possible must be done to reestablish the link. Digital nets are backed up by voice nets and vice versa. If digital communication is lost, resolve the problem on the voice net. If a station cannot be contacted on any fire support net, coordinate with maneuver counterparts to use their nets to reestablish communication. Unit SOPs must delineate exact actions to be taken to reestablish communication, and all personnel must be intimately familiar with those actions.

COMMUNICATIONS TIPS

DO	DON'T
Use the lowest power possible for effective transmissions.	Use homemade codes.
Make transmissions as short as possible.	Use homemade call signs.
Use the proper antenna (directional antenna if possible).	Start vehicles with radios on.
Use masking, if possible, to hide your signal.	Try to talk around sensitive information.
Use only authorized codes.	Display frequencies or call signs.
Remote radios if possible.	Create antenna *farms*.
Enforce net discipline.	
Authenticate.	
Try to work through jamming.	
Plan for the use of retrans.	

Retransmission

The FM VHF transmission distances are restricted by terrain and obstacles. The siting of radio equipment is often critical. The following are helpful hints for using FM retrans:

- As a minimum, make a map recon of the area of operation. Coordinate with the S2 and S3 during the planning phase.
- Analyze the terrain for optimum communications to support the scheme of maneuver.

- Select primary and alternate locations for retrans. Consider accessibility, defense, and logistical support.
- Arrange the timetable for site occupation and net operation. Don't wait until retrans is needed before sending it out.
- Ensure operators are well trained. They must be able to provide manual relay if they have equipment failures.
- Ensure operators are aware of the tactical situation.
- Ensure users understand how retrans works.

Communications Planning Ranges

The table below is to be used in communications planning. The ranges presented here were determined under ideal conditions; weather and terrain may have drastic degrading influences.

PLANNING RANGES FOR FIRE SUPPORT RADIOS

RADIO	RANGE (KM)[1]	
	Low Power	High Power
AN/PRC-77 with whip antenna	8	NA
AN/PRC-77 with long-wire antenna (AT-984/G)	28	NA
AN/GRC-160 with whip antenna	8	NA
AN/GRC-160 with RC-292, OE-254, or OE-303 antenna	19	NA
AN/GRC-160 with long-wire antenna (AT-984/G)	28	NA
AN/VRC-46 with whip antenna	8	40
AN/VRC-46 with OE-254, RC-292, or OE-303 antenna	19	58

[1]The normal planning range for the AN/GRC-160 series is 8 km; for the AN/VRC-46 series, it is 40 km. The above extended ranges are achieved by use of various antenna arrays.

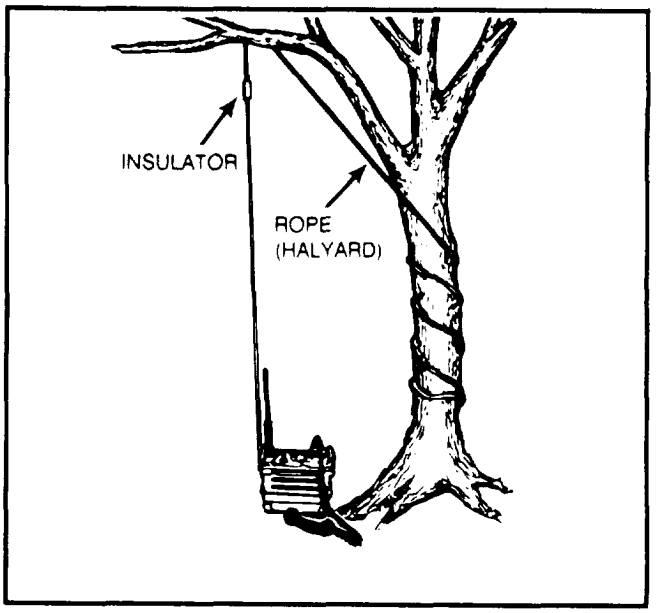
Field-Expedient Antennas

Poor or erratic radio communications may be the result of excessive distances between radios, unfavorable terrain or weather, or defective equipment. All fire support personnel must understand the application of field-expedient antennas for maintaining or enhancing communications and for ECCM. Regardless of the type of antenna used, proper maintenance must be performed to get the optimum performance from the equipment. The field-expedient antennas discussed below are relatively simple, easy to construct from available materials, and highly effective.

Replacement Whip Antenna

In a static position, a broken whip antenna may be replaced by use of WD-1 communications wire and an overhead branch or some support assembly. Cut a 10-foot piece of wire, attach an insulator to one end, and use a rope attached to the insulator to elevate the antenna. Strip about 1 inch of insulation from the end to be attached to the radio. Loosen the antenna base on the radio, place the bare wire between the antenna base and the antenna support receptacle, and retighten the antenna base. Ensure the improvised antenna is vertical.

REPLACEMENT WHIP ANTENNA



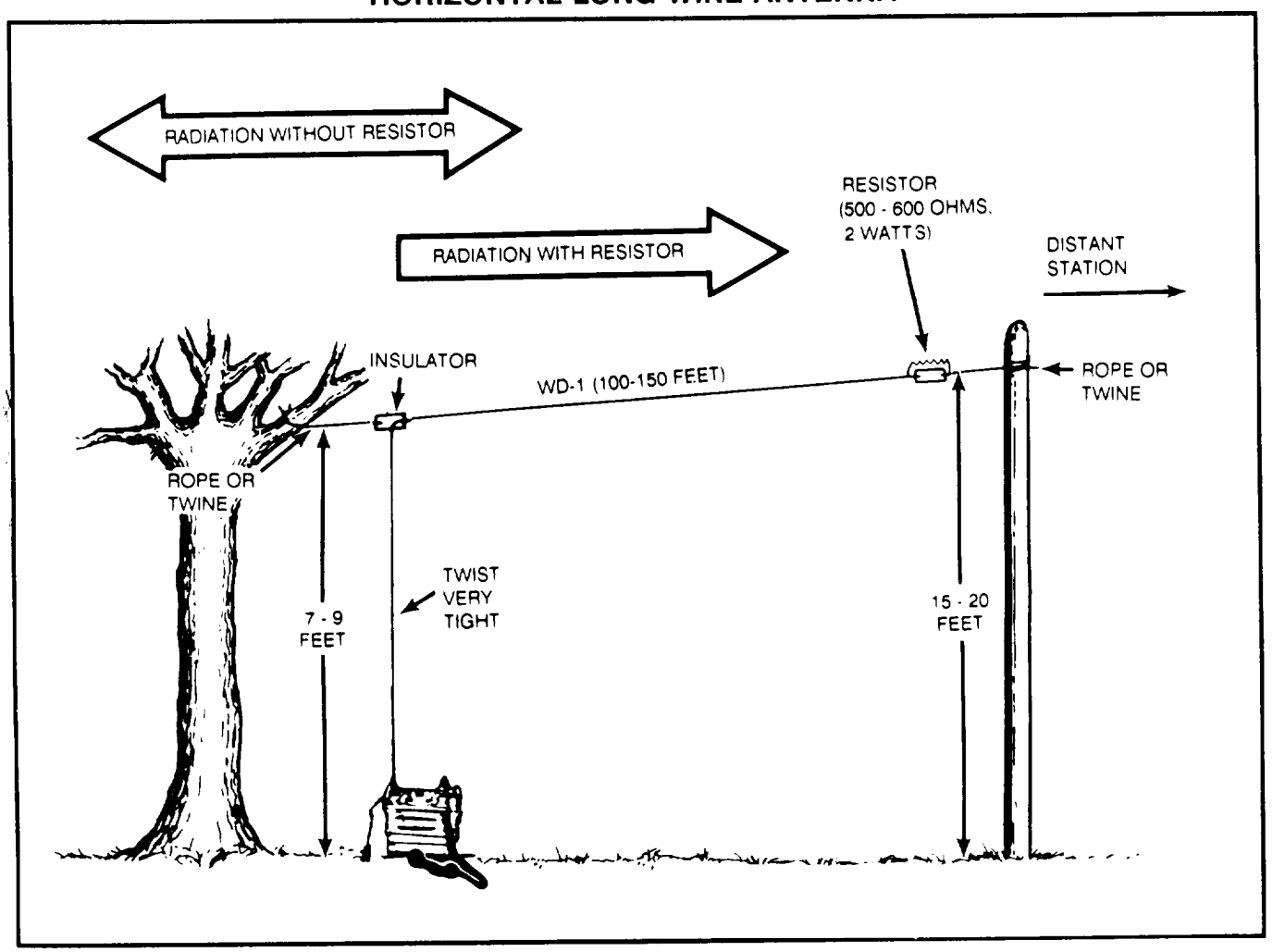
Horizontal Long-Wire Antenna

This is probably the simplest, yet most effective, antenna for communicating over long distances. Maximum radiation is off the ends of this antenna; thus, it is highly directional. It not only increases the range of transmission and reception, but it tends also to reject or reduce signals from other directions. This makes it an excellent antijamming device.

WD-1 is ideal for this antenna. The wire must be 100 to 150 feet long. Tightly twist the first section of the WD-1, and connect the end between the antenna base and the antenna support receptacle on the radio. The wire must be adequately insulated to prevent accidental grounding. The antenna should be erected at least 7 to 9 feet high at the radio and 15 to 20 feet above ground at the other end. Connect the other end to a pole or a tree in the direction in which communication is required. This ground clearance is necessary to prevent accidents or injuries involving personnel or vehicle traffic.

To make this a one-way (unidirectional) antenna, add a resistor at the end toward the distant station. A dead flashlight battery BA-30 makes an ideal resistor for low-power radios. Attach a nail or screw to each end of the battery, ensuring they don't touch, and connect the wire to each.

HORIZONTAL LONG-WIRE ANTENNA



Center-Fed Doublet Antenna

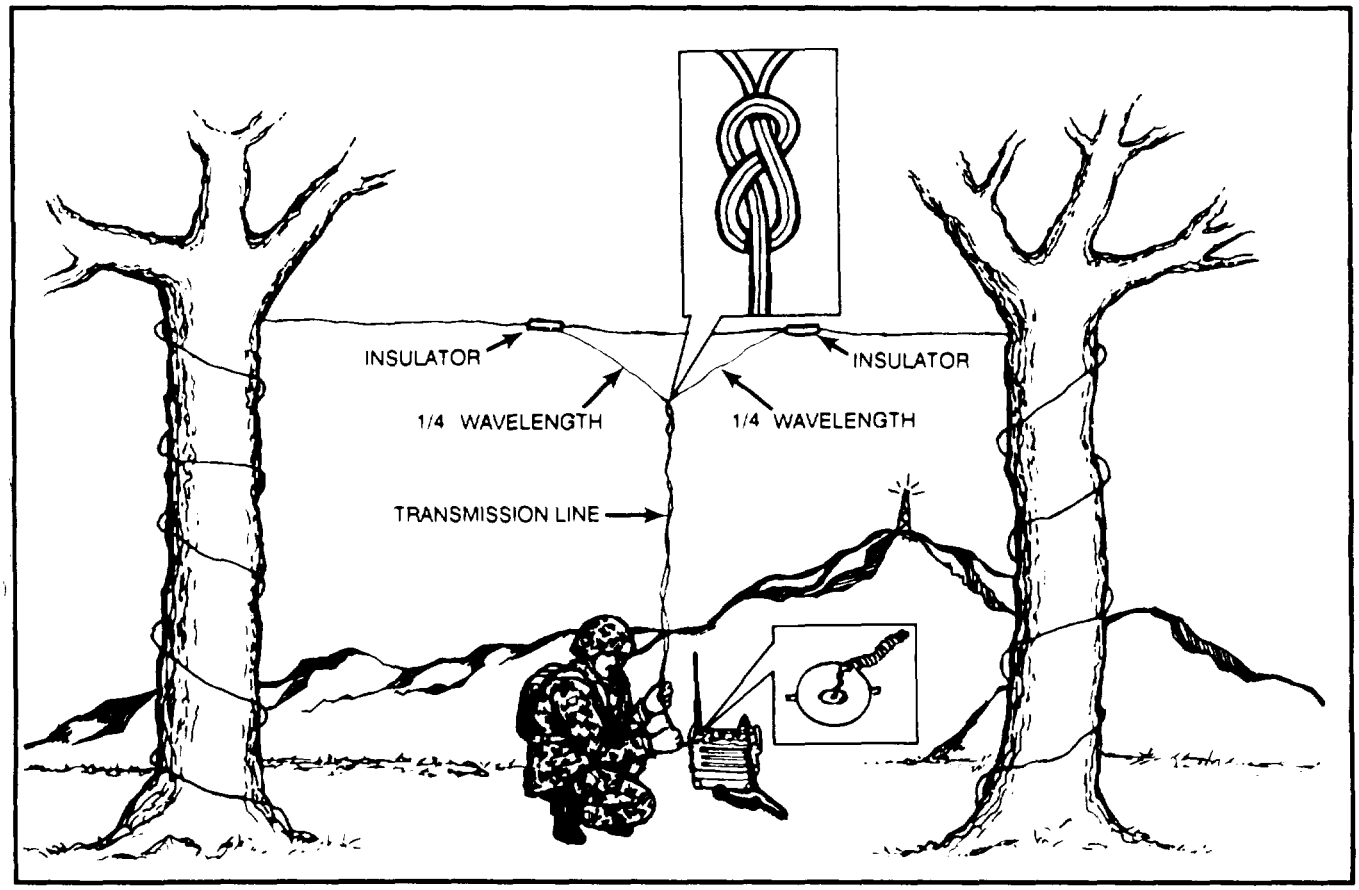
The center-fed doublet is an effective two-way (bidirectional) antenna. It is particularly efficient in jungle environments and for ECCM if both the sending and receiving stations are using the same type of antenna. Unlike the whip and many other antennas discussed in this appendix, this antenna is electronically horizontal and will not communicate with those that are electronically vertical.

The length of each element is critical and depends on the operating frequency. This length must be one-quarter wavelength. To determine the length of each element in feet, divide 468 by the frequency in megahertz (which gives you one-half wavelength). Then divide this result by 2 to get one-quarter wavelength in feet. An example using the operating frequency of 46.80 MHz follows:

468 ÷ 46.80 = 10; 10÷2= 5 feet; so each element is 5 feet long.

After determining the length of each element, construct the antenna by measuring off slightly more than the required length of wire and tie a figure-eight knot at that point. Separate the wire into the elements, and attach insulators at each end. Ensure the elements are the exact length required. Tightly twist the remaining wire going to the radio to make a transmission cable, and strip each end of the wire. Put one wire into the center of the antenna cable connector, and attach the other wire to the metal case of the radio. Attach the insulators to the rope to permit erecting the antenna between two trees or other support assemblies. Raise the antenna 20 to 30 feet, and ensure the broadside is directed toward the receiving station(s).

CENTER-FED DOUBLET ANTENNA

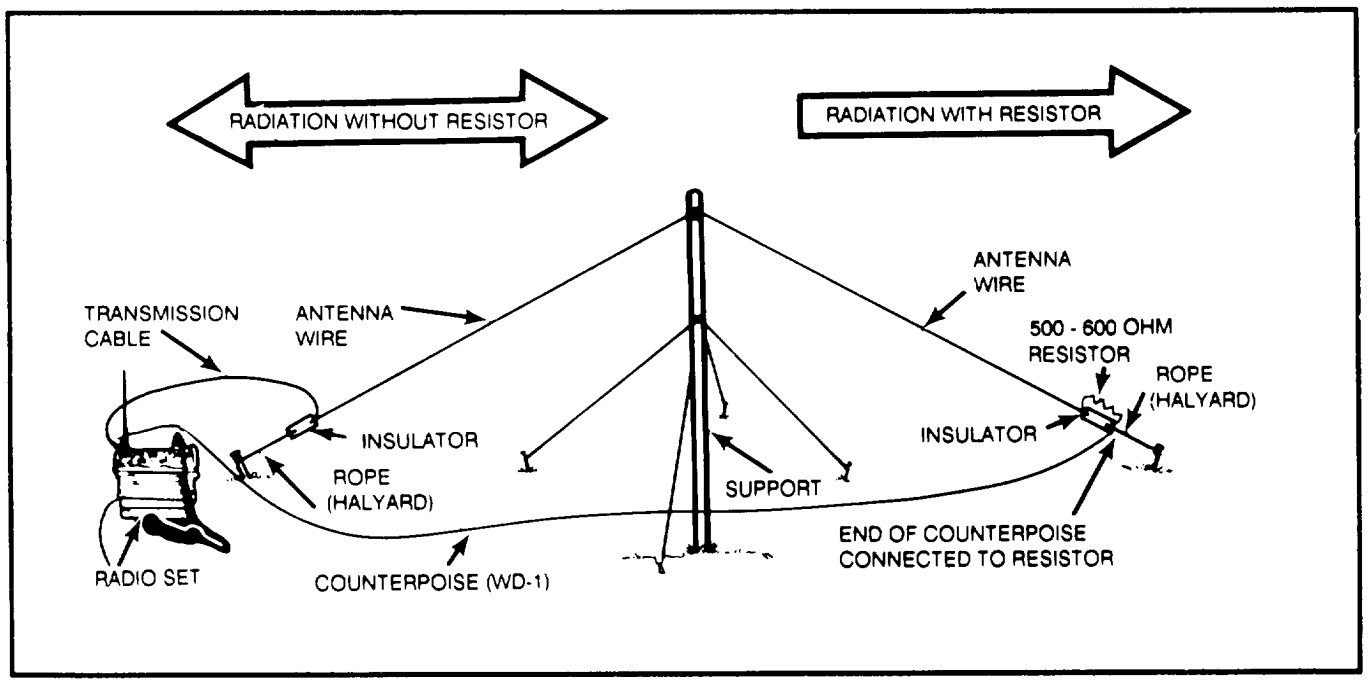


Vertical Half-Rhombic Antenna

The typical vertical half-rhombic antenna consists of 100 to 150 feet of WD-1 wire on a 30- to 45-foot-high support. The support should be centered with approximately half of the wire on each side. Attach insulators to the ends, and fasten rope to these insulators. This permits the ends to be tied down to stakes and the antenna element to be insulated from a ground. Make a transmission cable by tightly twisting the section of WD-1 coming from the radio end of the antenna element. Strip the ends of the cable approximately 1 inch, and connect these leads between the antenna base and the antenna support receptacle on the radio. The antenna in this configuration is a two-way (bidirectional) antenna.

To make this a one-way (unidirectional) antenna, add a resistor at the end toward the distant station. A dead flashlight battery BA-30 makes an ideal resistor for low-power radios. Attach a nail or screw to each end of the battery, ensuring they don't touch, and connect the wire to each.

VERTICAL HALF-RHOMBIC ANTENNA WITH RESISTOR



Resistors and Field-Expedient Resistors

Resistors are used to draw the signal in the desired direction of transmission.

Resistors used to construct the long-wire and half-rhombic antennas are readily available through supply channels and local radio repair shops. These resistors must have a resistance of 500 to 600 ohms and must be at least half the wattage of the transmitter power output. For example, a 600-ohm, 2-watt resistor works with the AN/PRC-77. Typical power outputs for combat net radios are as follows:

- AN/VRC- 12 series (-46, -47, and so forth):
  - High power = 35 watts (minimum).
  - Low power = 0.5 to 8 watts.
- AN/PRC-77 = 4 watts.
- SINCGARS = 50 watts.

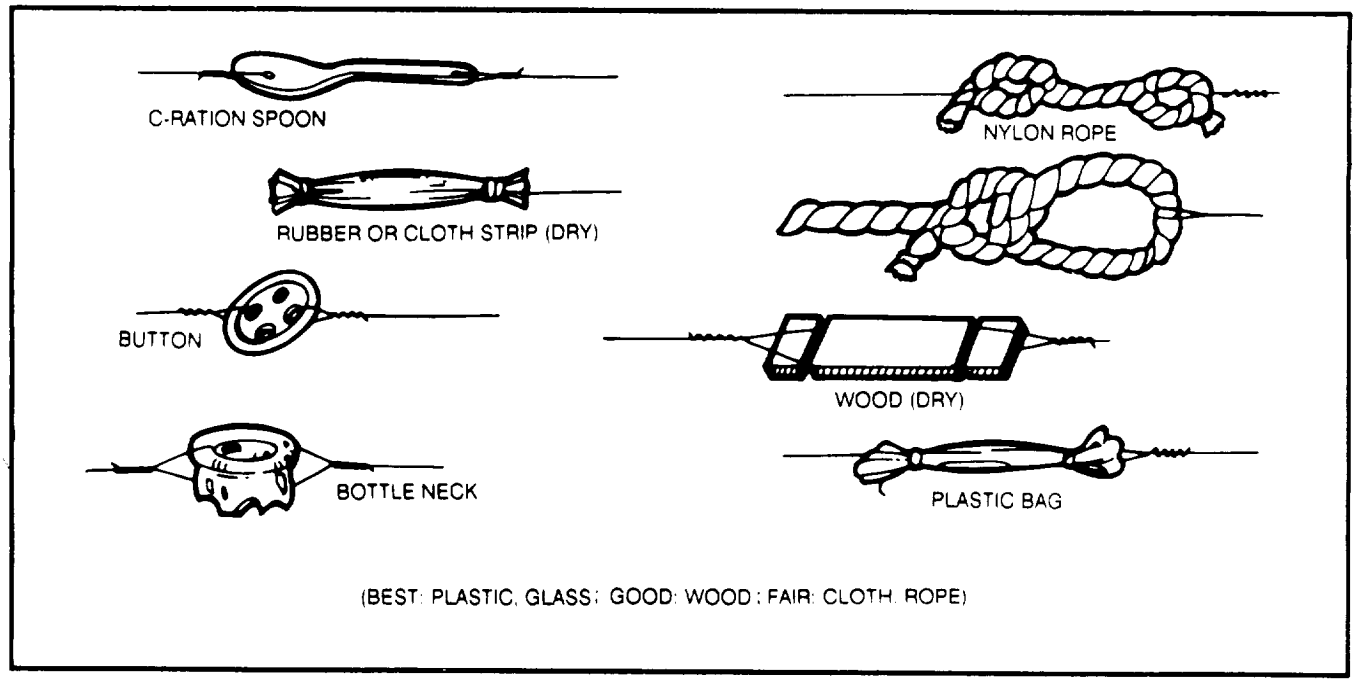
NOTE: SINCGARS radios do not perform frequency hopping very well with field-expedient antennas, but any antenna Is better than none at all. The use of a field-expedient antenna may degrade the SINCGARS to a single-channel operation, but it will permit communication.

Field-expedient resistors should be of the same values as those listed above, approximately 500 to 600 ohms at about half the wattage output. A BA-30 with nails driven into each end will approximate 500 to 600 ohms at 1 to 3 watts. An earplug container with holes drilled in the case opposite each other and filled with sand and a few drops of crankcase oil will work much like the battery.

Field-Expedient Insulators

Insulators keep the signal from going in an unwanted direction. Almost anything that will not conduct electricity but that has some strength can be an insulator. The very best insulators are glass, plastic, and rubber. Less effective but still usable are cloth, wood, and rope; however, these are not good when wet.

FIELD-EXPEDIENT INSULATORS



Extended-Range Communication

Communication is necessary in long-range, cross-FLOT operations such as raids or air assault operations. Extensive consideration, planning, and coordination are required for those units with no long-range communications assets. FM retrans is limited during these types of operations by distance, terrain, obstacles, and possible Threat forces. The following are a few considerations for long-range operations:

- AM voice radios do not depend on terrain. They will transmit greater distances, but their electronic signature may make them vulnerable to enemy radio electronic combat.
- The single-channel tactical satellite (TACSAT) may be employed when use of FM is limited.
- Aerial retrans may be coordinated for use behind or near the FLOT.
- Use of AM or TACSAT might be coordinated through the division signal officer or the supported unit.
- Other considerations might include –
  - Experienced operators to work the equipment.
  - Frequency allocations and propagation.
  - Location of satellite (magnetic azimuth).
  - Logistics to support nonorganic communications equipment (batteries, spare parts, maintenance).

NOTE: The US Army Signal School is in the process of replacing the terms *FM (frequency modulated)* and *AM or AM/SSB (amplitude modulated and single sideband)* in most radio net titles with terms more closely denoting frequency range. The following frequency range designations will be used:

- HF — high frequency (replacing AM/SSB).
- VHF — very high frequency (replacing FM).